

Title	A REVIEW OF THE JAPANESE SPECIES OF ALCYONIUM, WITH DESCRIPTIONS OF TWO NEW SPECIES AND AN ALMOST FORGOTTEN RARE SPECIES (OCTOCORALLIA, ALCYONACEA)
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Citation	PUBLICATIONS OF THE SETO MARINE BIOLOGICAL LABORATORY (1976), 23(3-5): 191-204
Issue Date	1976-10-30
URL	http://hdl.handle.net/2433/175942
Right	
Type	Departmental Bulletin Paper
Textversion	publisher

**A REVIEW OF THE JAPANESE SPECIES OF *ALCYONIUM*,
WITH DESCRIPTIONS OF TWO NEW SPECIES AND
AN ALMOST FORGOTTEN RARE SPECIES
(*OCTOCORALLIA*, *ALCYONACEA*)¹⁾**

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With Text-figures 1-5 and Plates I-II

Abstract

Among the monomorphic genus *Alcyonium* Linné found in Japanese waters, two new species, *A. robustum* and *A. okinawanum*, are described and a longtime forgotten rare species from Sagami Bay is redescribed, newly referring to the Mediterranean species *A. acaule* Marion.

In addition, all the previously recorded species from Japanese waters under the name of *Alcyonium* are reviewed, with the emendation of their generic status.

Introduction

The monotypic genus *Alcyonium* Linné (1758) was erected for a species *A. digitatum* Linné common in the northern Atlantic seas.

In earlier decades, this genus had often been confused with any other dimorphic genera such as *Anthomastus* Verrill, *Sarcophyton* Lesson, *Lobophytum* Marenzeller and *Sinularia* May (= *Sclerophytum* Pratt).

Various revisionary attempts have often been made after the comprehensive taxonomic studies by Kükenthal (1906a, b) and Lüttschwager (1915, 1922, 1926), and some species have been transferred to other monomorphic genera such as *Metcalcyonium* (Pfeffer, 1888), *Cladiella* (Gray, 1869; also known as *Lobularia* or *Microspicularia*) and *Parerythropodium* (Kükenthal, 1916).

Concerning the more primitive monomorphic genus *Bellonella* (Gray, 1862), which was confused with *Nidalia* (Gray, 1835) by Kükenthal (1906), I already discussed nomenclaturally (Utinomi, 1957, 1958).

Concerning the other monomorphic genus *Alcyonium* s. str. (= *Eualcyonium* Lüttschwager, 1922 pars) occurring in Japanese waters, Kükenthal (1906b) first described a new species *A. gracillimum* from the Sagami Bay off Misaki. Subsequently, Nutting (1912) mistakenly referred an apparently resembling northern specimen collected by the U.S. Fisheries steamer "Albatross" from the Okhotsk Sea to this species and also a similar specimen obtained from the west of the Sahalin Island described under the

1) Contributions from the Seto Marine Biological Laboratory, No. 622.

name of *A. kükenthali*, n. sp. As to their affinity see p. 201 in the following account.

Prior to this "Albatross" Cruise during 1906, Verrill (1869, p. 191) recorded a species as '*Alcyonium?*' in his preliminary report on the polyps and corals collected during the U. S. N. North Pacific Exploring Expedition 1853 to 1856 and Dr. Wm. Stimpson, naturalist to the expedition, with brief mentionings: "This species is as yet known only from a small and imperfect specimen. Not having had an opportunity to examine its spicula, I am unable to refer it to its proper genus. It cannot belong to *Lobularia* as defined by Dr. Gray." (Verrill, 1869, Proc. Essex Inst., 6:46).

In all probability, however, it may be deduced that the octocorals early recorded by both Verrill and Nutting from the Sea of Okhotsk may be a boreal nephtheid, now known as *Gersemia rubiformis* (Ehrenberg), not an alcyoniid species (cf. Utinomi, 1961, pp. 232-236).

Furthermore noteworthy is the fact that the earliest record of another remarkable species of *Alcyonium* was made by a famous old zoologist, Isao Ijima, then Professor of the University of Tokyo, in his monumental standard text-book of zoology, "Dôbutsugaku Teiyô (A Manual of Zoology)" (First published in March, 1918), just 12 years later than the description of *Alcyonium gracillimum* by Kükenthal (1906) from Sagami Bay, mostly based on Haberer's and Doflein's collections from Sagami Bay. The details of this *Alcyonium* will be discussed in later pages.

In this connection, I tried to revise all the earlier records of octocorals originally referred to the genus *Alcyonium* from the available literature according to the recently recognized conception of the allied genera.

Acknowledgments

I am very much indebted to Dr. Itiro Tomiyama, then the Director of the Misaki Marine Biological Station and now of the Biological Laboratory of the Imperial Household, Tokyo, for the transference of the unobtainable specimens of *A. acaule* for detailed study and permanent preservation, and Professor Kiyoshi Yamazato of the University of Ryukyus and also to Mr. Torao Yamamoto, president of the Nanki Biological Society for the gift of specimens of new species, *A. okinawanum* and *A. robustum* respectively, both of which are now kept in the type specimen collections of the Seto Marine Biological Laboratory. My thanks are also extended to Dr. Eiji Harada of the same Laboratory and to Mr. Yoshihisa Koyama of the Gakken Publishing Co., Ltd., Tokyo for preparing fine color and monochrome photographs appeared in this paper.

The authorities of the Zoological Station of Naples, Italy have kindly sent me the well preserved specimens of the Mediterranean *Alcyonium* species (*A. acaule* and *A. palmatum*), together with *Cornularia cornucopiae* as well as a scleractinian *Astroides calycularis* for comparative study and exchanges.

I. Description of *Alcyonium robustum*, sp. nov.*Alcyonium robustum* Utinomi, sp. nov.Nom. Jap.: Kintoki-umitosaka²⁾, nom. nov.

(Text-figs. 1-2; Plate I, figs. 1-2)

Diagnosis.—Colony rather tall, candelabrum-shaped, exceedingly robust, solid in texture and deep red either in life or in dry state; polypiferous capitulum formed of a few long, upright palmate lobes, often with short side branches and short, thick sterile stalk spreading over rocky substratum; lobes and branches digitate, uniformly round in section, uniformly covered with autozooids, arranging in longitudinal rows; anthocodiae and anthosteles elongate, armed with warty spindles or tuberculate cylinders peripherally in longitudinal rows; lacking crown rows; inner cortical layer of lobes and stalk contain numerous tuberculate spheres or short-waisted capstans, either red-colored or colorless; interior rather flaccid, only containing pink-colored less-tuberculate spheres or disc-formed spicules in fewer numbers; Living on rocky bottom of deeper depth (120–150 meters).

Holotype.—Off Minabe on the eastern coast of Kii Strait, middle Japan, depth about 120–150 meters, on a conglomerate rock-debris; 3 April, 1973. Torao Yamamoto, collector. SMBL-Type No. 249.

Coloration.—Carmine-red on the outer surface, translucent pinkish hue in fully extended polyps, when alive in aquaria kept shortly after collected by gill-nets for catching the spiny lobsters (See Plate I, fig. 2).

When dried or preserved in alcohol, it appears to be deep-red (See Plate I, fig. 1).

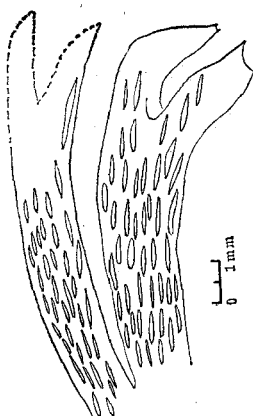
General appearance.—The holotype specimen is apparently candelabrumlike in the mode of growth, instead of low, fleshy, knobby form as seen in the related common species *A. gracillimum* Kükenthal (Plate I, fig. 3 in living state) and of a short arborescent or clavate form as seen in the rare species *A. cf. acaule* Marion preserved in alcohol (Plate I, fig. 4).

It measures 80 mm in total height and 50 mm in maximum breadth. So, the colony is much larger and taller than both of the other species mentioned above, occurring in middle Japan.

Its lower stem is attached firmly to a conglomerate rock-debris partly encrusted by a bryozoan *Celleporina costazii* (Audouin), is thickened and laterally flattened, being about 30×15 mm in extent and about 20 mm in height where the outer surface is free from zooids.

The cortex of the lobes and basal stalk is exceedingly thick and very rigid. The polyparium consists of three erect digitate main lobes with short side branches approximately arranged in one row, arising on the flattened basal stalk, so that they may take a palmate form as a whole. These erect lobes are uniformly cylindrical up

2) Originally derived from the name of Sakata-Kintoki, who was a traditional hero in old Japan, as referring to its deep red coloration of body and then usually used as vernacular name for various red-colored Holocentrid fish and carrot (a kind of vegetables).

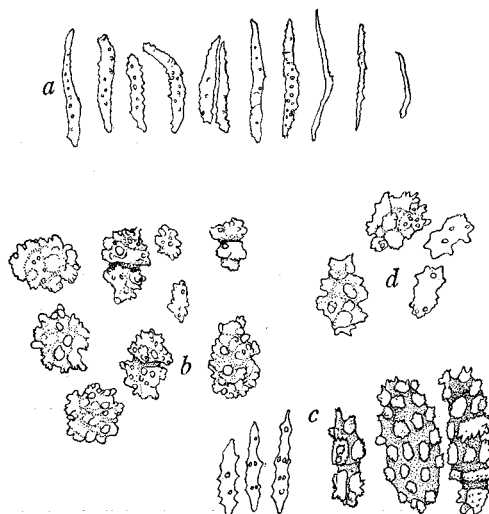
Text-fig. 1. *Alcyonium robustum*, sp. nov.

Two fully extended polyps, showing the arrangement of spicules on the surface of wall, rather schematically.

to rounded tips, measuring about 4 cm to 6 cm in length and about 1.0 cm to 1.5 cm in basal diameter. The side-branches arising either obliquely upwards or horizontally and younger lobes arising from the basal stalk are about 1.5 cm to 2 cm in length and about 4 mm to 6 mm in basal diameter.

The calyces, within which the autozooids are completely retractile, are arranged uniformly or somewhat in longitudinal rows and about 1 or 2 mm apart from each other on all sides of lobes and branches. They are low hillocks, about 0.5–0.7 mm high and 1.5 mm across in dry state.

The anthocodiae, when fully extended in life, are elongate, horn-like in appearance, up to 2 mm in length, including tentacles (Text-fig. 1; Plate I, fig. 2).

Text-fig. 2. *Alcyonium robustum*, sp. nov.

a, Anthocodial spicules; *b*, inner cortical spicules from sterile stalk, *c*, outer cortical spicules from surface of lobes and calyces; *d*, coenenchymal spicules from interior of lobes. ($\times 113$)

Texture and coloration.—The cortex is exceedingly thick and very rigid in texture and deep red in color, while the interior is rather flaccid and almost colorless.

Spiculation.—In the inner layer of the cortex of the sterile stalk and polypiferous lobes there are numerous tuberculate spheres or short-waisted capstans, about 0.08 to 0.12 mm long, either red-colored or colorless (Text-fig. 2, *b*), while the surface layer contains slender spindles and larger tuberculate cylinders (with large warts more or less girdled), about 0.1 mm to 0.22 mm long, mostly red-colored (Text-fig. 2, *c*).

The coenenchymal spicules in the interior of lobes are mostly less-tuberculate spheres or indistinctly waisted capstans or smaller disc-formed ones, about 0.05–0.12 mm, mostly pink-colored to colorless (Text-fig. 2, *d*).

The anthocodial spicules are arranged apparently not *en chevron* but longitudinally, and lack crown rows below. These point spicules are all smooth needles or slender spindles with minute warts, about 0.1–0.12 mm long, vividly red-colored (Text-fig. 2, *a*).

Remarks.—In the mode of branching and the arrangement of zooids on the surface of the lobes and branches, this new species most resembles *A. glomeratum* Hassal (*e. g.* Hickson, 1895, pl. 36, fig. 2) and *A. acaule* Marion (*e. g.* Verveveldt, 1964, pl. XI, figs. 1–6). However, its largeness in size and rigidity verify it a valid species distinct from both of *Alcyonium* species hitherto known from the northern Atlantic.

For differentiating from the common Japanese species *A. gracillimum* Kükenthal (*e. g.* Kükenthal, 1906b, pl. I, fig. 3 and the present paper, pl. I, fig. 3), I recapitulate the main characters of both species in the following table.

<i>A. gracillimum</i> K.	<i>A. robustum</i> sp. nov.
1. Colony small, low, irregularly 5–10 cm in height, rather soft and flaccid.	1. Colony much larger, palmate, 8 cm in height, 5 cm wide in the type, very rigid.
2. Polypiferous lobes obscurely delimited from sterile stalk.	2. Polypiferous lobes distinctly delimited from sterile stalk.
3. Lobes rather low, knobby and transversely wrinkled.	3. Lobes long, digitate and arranged in one row, obscurely furrowed longitudinally.
4. Zooids irregularly arranged as knobby mass on whole branches. Only a few zooids placed solitarily on surface of lobes or stem.	4. Zooids longitudinally arranged with intervals of 1–1.5 mm.
5. Colony usually orange-colored.	5. Colony usually deep red.
6. Anthocodiae low conical, about 2.5 mm long and 2 mm wide, with chevroned point spicules (much warty spindles) and 3–4 rows of crown spicules.	6. Anthocodiae elongate horn-like in form, with smooth or less warty point spicules longitudinally arranged, lacking crown spicules.
7. Outer layer of stem and lobes thin, contains blunt-ended spindles, mostly 0.15–0.3 mm long.	7. Cortex of lobes and stalk very thick, composed of two layers. Its outer layer contains slender spindles and tuberculate cylinders about 0.1–0.22 mm long and inner layer contains warty spheres or capstans, about 0.05–0.12 mm long.
8. Coenenchymal spicules are large, plump spindles with compound warts, up to 1 mm long, mostly colorless.	8. Coenenchymal spicules are small, less-warty spheres or discs, about 0.05–0.12 mm, mostly pink-colored.

II. Description of *Alcyonium okinawanum*, sp. nov.

Alcyonium okinawanum Utinomi, sp. nov.

Nom. Jap.: Okinawa-umitosaka, nom. nov.

(Text-fig. 3; Plate II, figs. 5-6)

Diagnosis.—Colony very flaccid, consisting of membranous basal stalk and irregularly ramified flexible lobes densely covered with papillate autozooids; greenish brown in life; fully extended anthocodiae with 7-13 pairs of digitate pinnules devoid of spicules; coenenchymal spicules in both surface and interior mostly minute smooth rodlets about 0.2-0.3 mm long; living on shallow-water coral reef of Okinawa Island.

Holotype.—Nagusuku coast of Itoman-chô, southwest of Okinawa-jima, Ryukyu Archipelago, depth not mentioned but possibly on mean sea-level. 5 April, 1962. Kiyoshi Yamazato, collector. SMBL-Type No. 268.

General appearance.—The holotype specimen is preserved in alcohol, so that



Text-fig. 3. *Alcyonium okinawanum*, sp. nov.

a, Distal part of fully stretched lobes slightly branched; *b*, 3 fully extended tentacles, showing varied length of pinnules; *c*, cortical spicules from outer layer of sterile stalk; *d*, coenenchymal spicules from canal-walls of lobes.

(Scales *a* and *b* respectively apply to adjacent figures. The scale at the bottom only applies to Figs. *c* and *d*.)

it may be somewhat contracted. It measures 5–6 cm in total height, with maximum expanse of about 5 cm.

The sterile stalk is very short and flattened, spreading over a dead coral block. Its basal diameter is 2 cm \times 4 cm intact. It widens upwards and passes into the polyparium, which consists of 4 primary lobes, and then gives off a few shorter branches. The distal part of the main lobes and branches (Text-fig. 3, *a*) are all digitate in form, uniformly cylindrical to elongate conical, being about 10–20 mm long and 5–10 mm wide, directing upwards or obliquely upwards. They are all flabby in texture and olive buff in color.

Around these lobes many papillate autozooids are densely distributed, decreasing to the distal ends. Each zooid is about 1.5 mm wide and slightly longer, sometimes with fully extended tentacles clearly detectable.

The fully expanded anthocodiae have 8 fimbriate tentacles, about 2 mm long. Usually, the pinnules are of 10–13 pairs and their proximal 2 pairs are much longer up to 0.5 mm long, while the distal ones may be one-half in length or obsolete (Text-fig. 3, *b*).

Spiculation.—The anthocodiae, including tentacles, lack spicules.

The spicules contained in both the surface layer and canal-walls of lobes are predominantly smooth tiny rods, measuring about 0.03–0.15 mm in length, but extraordinarily large, similar-shaped, smooth rods (3 \times 0.5 mm) are occasionally found (Text-fig. 3, *c-d*).

Remarks.—The external appearance and flabby texture of this specimen remind of *A. aspiculatum* Tixier-Durivault from Australia (Tixier-Durivault, 1966a, p. 706, fig. 1) and *A. flaccidum* Tixier-Durivault from Madagascar (Tixier-Durivault, 1966b, p. 29, figs. 10–11; Verseveldt, 1971, p. 5, pl. I, fig. 1).

However, the spiculation mentioned above seems to be related to that of *A. utinonii* Verseveldt (1971, p. 7, fig. 3) from Madagascar, but the absence of such spicules as sharply ended spindles and hexagonal discs, characteristic to the latter species, deserves to establish a new species for the present specimen from Okinawa, as distinct from both species.

Although morphologically different, these recently found *Alcyonium*-species may belong to the same group, because of the occurrence on the shallow-water coral reef and of the dull coloration probably due to the close association of zooxanthellae or zoochlorella in the coenenchyme.

III. Redescription of Ijima's '*Alcyonium* sp.', Referable to *Alcyonium acaule* Marion

Alcyonium cf. *acaule* Marion

Nom. Jap.: Hime-umitosaka (Utinomi, 1974)

(Text-figs. 4–5; Plate I, fig. 4)

History of material.—Famous Japanese grand zoologist Isao Ijima, then Professor

of the Imperial University of Tokyo, gave a fine figure of an arborescent form of *Alcyonium* obtained from Sagami Bay, together with its spicules in his monumental textbook "Dôbutsugaku Teiyô" (1918, Tokyo, p. 326, fig. 374)³⁾.

Material examined.—Five specimens (from 7 mm to 40 mm in total length) and 2 younger fragments.

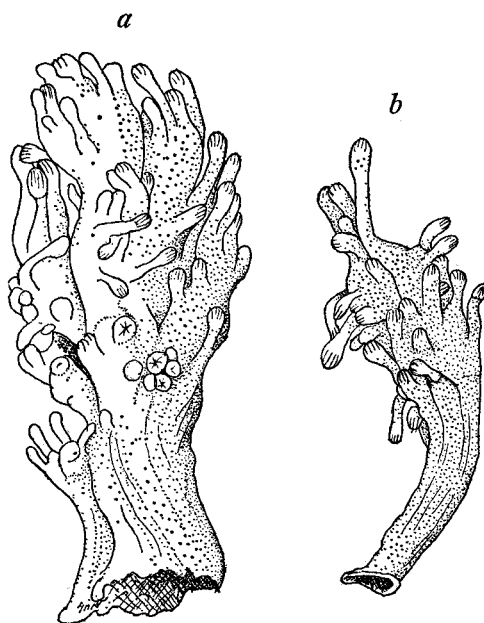
These valuable specimens, probably collected by Kumakichi Aoki, a well-known collector at the Misaki Marine Biological Station, from off Misaki where the Station is placed, in his life time.

Unfortunately its collecting data and occurring depth are unknown at present.

These specimens had been deposited at the specimens-depositing room in that Station for many years before 1951, and afterwards transferred to the Museum of the Seto Marine Biological Laboratory of Kyoto University, and then permanently deposited, registering as SMBL-Rare No. 268.

A colony represented by the aforementioned Ijima's figure seems to correspond with largest one retained at present (See Text-fig. 4, *a* and Plate I, fig. 4).

Redescription of these specimens forgotten and neglected for many years and hitherto never found again from anywhere in Japanese waters. Among the specimens examined here, the largest one is a branched arborescent colony, about 4 cm



Text-fig. 4. *Alcyonium* cf. *acaule* Marion. (SMBL-Rare No. 268).
a, Largest branched specimen (the same as Pl. I, fig. 4); *b*, smaller unbranched specimen. ($\times 1.6$)

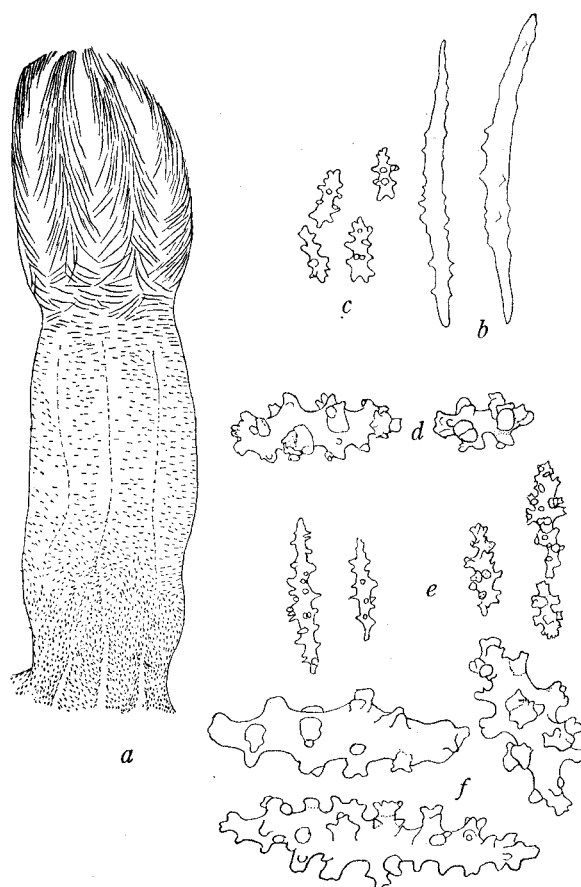
3) Presumably, this figure of total form and contained spicules might had been made originally by his pupil Kumao Kinoshita, the late distinguished specialist on Octocorallia.

in height and 10 mm \times 15 mm in extent of the base, detached from the substratum.

The polyparium consists of 4 erect, club-shaped lobes, about 10–20 mm long and terminally about 5–8 mm wide. The sterile stalk is about 10 mm long, so approximately less than one-half of the total height, and longitudinally furrowed or wrinkled, probably due to a longtime preservation. In addition, a young daughter colony (about 10 mm long and 3 mm wide) is arisen from the side of the basal disc. The remaining smaller colonies (Text-fig. 4, *b*) are unbranched, consisting of a clavate polyparium and a slender short sterile stalk, measuring 1 cm, 2 cm and 2.5 cm in height respectively.

They are uniformly dark wine-red in color, although the partly extended large polyps are slightly paler.

The autozoid (Text-fig. 5, *a*), when partly extended, is large, about 3–5 mm



Text-fig. 5. *Alcyonium* cf. *acaule* Marion.

a, Well-grown polyp, showing the arrangement of spicules; *b*, anthocodial point spicules; *c*, spicules from neck zone; *d*, spicules from stalk cortex; *e*, spicules from calyx wall; *f*, spicules from canal-walls of sterile stalk.

(*a*, $\times 20$; *b-c*, $\times 80$; *d-f*, $\times 230$)

long, excluding tentacles withdrawn and bear 8 rows of steeply converging slender fusiform spicules on the surface of the head portion, below these similar spicules are arranged in transverse rows, not forming distinct crowns, and in the lower neck portion there are smaller warty rods loosely arranged in transverse rows, becoming more densely and irregularly basalwards.

Fully grown tentacles bear about 12 long pinnules on each side in the lower half of the length.

Spiculation.—The anthocodial spicules are scarcely warty spindles sharply pointed on both ends, about 0.17–0.44 mm long and 0.018 mm wide (Text-fig. 5, *b*). The anthostelar neck zone bears warty rods, about 0.05–0.018 mm long and 0.026 mm wide (Text-fig. 5, *c*). The cortical spicules in the sterile stalk are slightly longer, similar warty spindles with high warts sometimes girdled and the color varies from colorless to red (Text-fig. 5, *d*). Those from the calyx wall are high-warted spindles or club-like rods, about 0.06–0.18 mm long (Text-fig. 5, *e*). The coenenchymal spicules thickly filled in the canal-walls are more larger warty spindles, red-colored, about 0.08–0.2 mm long and 0.05 mm wide (Text-fig. 5, *f*).

Consideration on its affinity.—In looking at this old material which I have not ever encountered in Japanese waters, it struck me that the specimens, either branched or unbranched, still retain dark wine-red coloration and very like the figures or photographs of *Alcyonium acaule* Marion (1878), which has hitherto been believed to be endemic to the Mediterranean Sea, and also Pütter's figure of *Ammothea rubriflora* recorded only once from unknown locality (probably China Sea ?, after his original note) (cf. Pütter, 1900, p. 451, pl. 39, figs. 3 and 10). Accordingly, I compared it with the topotypic specimens of *A. acaule* and *A. palmatum* which had been sent to me from the Zoologi-Station of Naples, Italy (unbranched colony of the former, SMBL-Rare No. 225; branched colony of the latter, SMBL-Rare No. 224), and at the same time consulted available literatures (Koch, 1891; Studer, 1901; Kükenthal, 1907; J.A. Thomson, 1927; Verveeldt, 1964). As a result, I conclude herein that the specimens here concerned is certainly identified with *A. acaule* Marion.

So, the alleged names such as *Ammothea rubriflora* Pütter (1900) and *Alcyonium brinoniense* Kükenthal (1907), are to be discarded as junior synonyms of *Alcyonium acaule* Marion (1878).

In connection with this, it is not surprising that the 'Mediterranean' species such as this *A. acaule* does occur in the West Pacific, especially in the far easternmost Sagami Bay, too. As mentioned by Ekman (1953, p. 87): "Several of the Mediterranean warm-water animals have been regarded as relicts from the Tertiary Tethys Sea.", indeed there is faunistically a close relationship between the Sagami Bay and the Mediterranean Sea as far as the Octocorallia is concerned, for example the cases of *Paralcyonium elegans* M. Edw., *Daniela koreni* v. Koch (= *Cereopsis studeri* v. Koch) and *Bebryce mollis* Phil. recorded first from the Mediterranean (cf. e. g. Thomson and Dean, 1931; Stiasny, 1941; Utinomi, 1960; unpublished data).

IV. Revision of Other Species of *Alcyonium* Previously Recorded from Japanese Waters

Authors	Original names	Emended names
Stimpson (1855)	<i>Alcyonium agaricum</i> St.	<i>Sarcophyton agaricum</i> (after Verrill, 1865, p. 1900)
Verrill (1865)	<i>Alcyonium</i> sp. (from Hong Kong)	??
"	<i>Alcyonium</i> sp. (from Sea of Okhotsk)	' <i>Lobularia verrillii</i> ' (after Gray, 1869, p. 121; not ' <i>Lobularia</i> ' sensu Gray (after Verrill, 1869, p. 121) ??
Kükenthal (1906b)	<i>A. gracillimum</i> K.	valid (cf. Utinomi, 1954 and Imahara, 1975)
Nutting (1912)	<i>A. kukenthali</i> N.	<i>Gersemia rubiformis</i> (Ehrb.) (cf. Utinomi, 1961, p. 235)
"	<i>A. gracillimum</i> K. (from the west of Sahalin Is.)	<i>Gersemia rubiformis</i> (Ehrb.) (cf. Utinomi, 1961, loc. cit.)
Yamada (1950)	<i>A. pacificum</i> Y.	<i>Metcalcyonium pacificum</i> (Yamada) (cf. Uchida, 1969)
"	<i>A. muricatum</i> Y.	<i>Metcalcyonium muricatum</i> (Yamada)

REFERENCES

- Burchardt, E. 1902. Alcyonaceen von Thursday Island (Torresstrasse) und von Amboina. II. Alcyonaceen von Amboina. Denkschr. Med.-nat. Ges. Jena, **8**: 653-682, pls. LIV-LVII; Semon's Zool. Forschungen, V (reproduced).
- Dana, J.D. 1846. Zoophytes. U.S. Exploring Exped. during the years 1838-1842, 7. Philadelphia. Text (1846): vii+740 pp. Atlas (1849): 61 pls.
- 1859. Synopsis of the Report on the Zoophytes of the U.S. Exploring Expedition under C. Wilkes during the years 1838-1858. New Haven. [Reproduced publ. of the former]
- Deichmann, E. 1936. The Alcyonaria of the western part of the Atlantic Ocean. Mem. Mus. Comp. Zool. Harvard Coll, Cambridge, **53**: 317 pp., 37 pls.
- Ehrenberg, C.G. 1834. Die Corallenthiere des rothen Meeres, physiologisch untersucht und systematisch verzeichnet. K. Akad. Wiss. Abh., Berlin. 152 pp.
- Ellis, J. and Solander, D. 1786. The natural history of many curious and uncommon zoophytes, collected from various parts of the globe. London. xii+205 pp., 63 pls.
- Ekman, Sven 1953. Zoogeography of the sea. London and Beccles. xiv+417 pp.
- Gray, J.E. 1869. Notes on the fleshy Alcyonoid corals (*Alcyonium*, Linn., or Zoophytaria carnosa). Ann. Mag. nat. Hist., ser. 4, **3**: 117-131.
- Hickson, S.J. 1895. The anatomy of *Alcyonium digitatum*. Quart. J. micr. Sci., N.S., **37** (4): 343-388, pls. 36-39.
- 1930. On the classification of Alcyonaria. Proc. Zool. Soc. Lond., **1930** (15): 229-252.
- Ijima, Isao 1918. Dobutsugaku Teiyo (A Manual of Zoology) (In Japanese). Tokyo. 17+950+30 pp.
- Imahara, Y. 1975. Alcyonacea from the west coast of Izu Peninsula, central Japan. Thesis for Master of Fishery Science, Tokai Univ. (Unpublished).

- Klunzinger, C.B. 1877. Die Korallthiere des rothen Meeres. Erster Theil: Die Alcyonarien und Malacodermen. Berlin. 98 pp., 8 pls.
- Koch, G. von 1891. Die Alcyonacea des Golfes von Neapel. Mitt. Zool. Stat. Neapel, **9** (4): 652-676, pl. 25.
- Kükenthal, W. 1906a. Alcyonacea. Wiss. Ergebn. 'Valdivia' Exped., **13** (1): 1-111, pls. 1-12. Jena.
- 1906b. Japanische Alcyonaceen. Abhandl. K. Bayer. Akad. wiss. II Kl. Suppl. Bd. **1** (1): 1-86, pls. I-V. München.
- 1907. *Alcyonium brioniense* n. sp., Eine neues *Alcyonium* des Mittelmeeres. Jena. Zeitschr. wiss. Naturw., **42**: 61-72, pl. IV.
- 1916. Die Gorgonarien Westindiens. I. Scleraxonier. Zool. Jahrb. Suppl., **11** (15): 444-484, pl. 23.
- Linné, C. 1758. Systema naturae. 10th Edition. Holmie (Lipsiae, 1894, reproduced).
- Lüttschwager, H. 1915. Beiträge zu einer Revision der Familie Alcyoniidae. Arch. Naturgesch. Berlin, 1914 (A 10): 1-42.
- 1922. Alcyonarien von den Philippinen. I. Die Gattung *Alcyonium* Linnaeus. Philipp. J. Sci., **20** (5): 519-540, pl. 1.
- 1926. Die Gattung *Alcyonium* Linnaeus. Mitt. zool. Mus. Berlin, **12**: 279-289.
- Macfadyen, L.M.I. 1936. Alcyonaria (Stolonifera, Alcyonacea, Teleostacea and Gorgonacea). Great Barr. Reef Exped. Sci. Rep., **5** (2): 19-71, pls. I-V. London.
- Marion, A.F. 1878. Deux jours de Dragages dans le Golfe d'Alger. Rev. Sci. Nat., **7** (1). [Cited from Verseveldt, 1964.]
- 1882. Les Alcyonaires du Golfe de Marseille. C.R. Acad. Sci. Paris, **94**. [Cited from Stiasny, 1941.]
- May, W. 1900a (1899). Beiträge zur Systematik und Chorologie der Alcyonaceen. Jena. Zeitschr. Wiss., **33** (N.F. 26): 1-180, pls. I-V.
- 1900b. Die arktische, subarktische und subantarktische Alcyonaceenfauna. Fauna Arctica, **1**: 381-408, pls. I-X. Jena.
- Molander, A.R. 1915. Northern and arctic Invertebrates in the collection of the Swedish State Museum (Riksmuseum). VII. Alcyonacea. Kungl. Svenska Vetensk.-Akad. Handl., **51** (11): 1-94, pls. 1-3.
- 1918. Der Kelch als systematischer Character bei den Alcyonaceen. Ark. Zool., **11** (22): 1-12.
- 1929. Die Octactinarien. Further Zool. Res. Swedish Antarctic Exped., **2** (2): 1-86, pls. I-V. Stockholm.
- Nutting, C.C. 1912. Descriptions of the Alcyonaria collected by the U.S. Fisheries steamer "Albatross," mainly in Japanese waters, during 1906. Proc. U.S. Natl. Mus., **43** (1923): 1-104, pls. 1-21.
- Pax, F. and Müller, I. 1954-55. Die Korallentiere der Adria. Die Aquar. Terr. Zeitschr. (DATZ), **7-8**.
- Pfeffer, G. 1889. Zur Fauna von Süd-Georgiden. Jahrb. Hamburg Wiss. Anstalt, **6** (2): 49-55.
- Pratt, E.M. 1903. The Alcyonaria of the Maldives. Part II. The genera *Sarcophytum*, *Lobophytum*, *Sclerophytum*, and *Alcyonium*. In: Gardiner (ed.), Fauna and Geography of the Maldive Archipelagoes, **2** (1): 504-539, pls. 28-31.
- 1905. Report on some Alcyoniidae collected by Prof. Herdman at Ceylon in 1902. Ceylon Pearl Oyster Fisheries, Suppl. Rep. **19**: 247-268, pls. I-III.
- Pütter, A. 1900. Alcyonaceen des Breslauer Museums. Zool. Jahrb., Abt. Syst., **13** (5): 443-462, pls. 29-30.
- Roxas, H.A. 1933. Philippine Alcyonaria, II. The families Alcyoniidae and Nephthyidae. Philipp. J. Sci., **50** (4): 345-470, pls. 1-5.
- Stiasny, G. 1941. Alcyonaria und Gorgonaria aus dem Golf von Neapel. Pubbl. Staz. Zool., **19** (1): 1-47.
- Studer, Th. 1887. Versuch eines Systems der Alcyonaria. Arch. f. Naturgesch., **53** (I, 1): 1-74, pl. I.
- 1901. Alcyonaires provenant des campagnes de l'Hirondelle (1886-1888). Rés. Camp. Sci. Albert I Prince de Monaco, **20**: 1-64, pls. I-X. Monaco.

- Thomson, J.A. 1927. Alcyonaires provenant des campagnes de Prince Albert I de Monaco. *Ibid.*, **73**: 1-77, pls. I-VI. Monaco.
- and Dean, L.M.I. 1931. The Alcyonacea of the Siboga Expedition, with an addendum to the Gorgonacea. *Siboga-Expeditie, monogr. XIII*d. 227 pp., 28 pls. Leiden.
- and Mackinnon, D.L. 1911. The Alcyonarians of the "Thetis" Expedition. *Mem. Aust. Mus.*, **4** (13): 661-695, pls. LXI-LXXII.
- and Simpson, J.J. 1909. An account of the Alcyonaria collected by the Royal Indian Marine Survey ship "Investigator" in the Indian Ocean. Part II. The Alcyonarians of the littoral area. xviii+319 pp., 9 pls. Calcutta.
- Thomson, J. St. 1910. The Alcyonaria of the Cape of Good Hope and Natal. *Alcyonacea. Trans. roy. Soc. Edinb.*, **47** (3): 549-589, pls. I-IV.
- 1921. South African Alcyonacea. *Trans. roy. Soc. South Africa*, **9** (2): 149-175, pls. V-VI.
- 1923. Charts and comparisons of the distribution of South African Alcyonaria with statement of some of the problems of their dispersal. *Ibid.*, **11** (1): 45-84, charts I-II.
- Tixier-Durivault, A. 1948. Revision de la famille des Alcyoniidae. I. Genre *Lobularia* Ehrbg. (nec Lamarck). *Mém. Mus. Nat. Hist. nat. Paris, N.S.*, **23** (1): 1-256.
- 1954. Les Octocoralliaires d'Afrique du Sud. (I. Alcyonacea). *Bull. du Mus. Natl. Hist. nat. Paris, sér. 2*, **26** (1): 124-129, **26** (2): 261-268, **26** (3): 365-390, **26** (4): 526-533, **26** (5): 624-631.
- 1955. Alcyonaires Atlantiques intertropicaux. *Expéd. Oceanogr. Belge côtières Afric. Atlantique Sud* (1948-1949), *Res. Sci.*, **3** (4): 199-246. Bruxelles.
- 1966a. Quelques Octocoralliaires Australiens. *Bull. Mus. Natl. Paris, sér. 2*, **37** (4): 705-716. [P. 706—*A. aspiculatum*, n. sp.]
- 1966b. Octocoralliaires de Madagascar et des îles avoisinantes. *Faune de Madagascar*, **XXI**: 1-456, 399 text-figs. Paris.
- 1968. Les Octocoralliaires du Sudest Asiatique (Octocorallia of South East Asia). Singapore. pp. 5-31 (Mimeographed).
- 1970a. Les Octocoralliaires de Nha-Trang (Viet-Nam). *Cahiers du Pacifique*, no. 14: 115-236.
- 1970b. Les Octocoralliaires de Nouvelle-Calédonie. *L'Expéd. franc. sur les récifs coralliens de la Nouvelle Calédonie organisée, 1960-1963*, **IV**: 173-350. Paris.
- 1972. Nouvel apport d'Octocoralliaires de Madagascar et des îles avoisinantes. *Tethys Suppl.* **3**: 11-68.
- Uchida, T. 1969. On a northern Alcyonarian, *Alcyonium pacificum* Yamada. *Jour. Fac. Sci. Hokkaido Univ.*, ser. VI, *Zool.*, **17** (2): 397-399.
- Utinomi, H. 1954. Some Alcyoniid octocorals from Kii Coast, middle Japan. *Publ. Seto Mar. Biol. Lab.*, **4** (1): 43-55, pl. I.
- 1956 (2nd ed., 1969; 3rd ed., 1976). Coloured Illustrations of seashore animals of Japan. (in Japanese) Hoikusha Publ. Co., Osaka. 166 pp., 64 color pls. and 12 monochrome pls.
- 1957. The alcyonarian genus *Bellonella* from Japan, with descriptions of two new species. *Publ. Seto Mar. Biol. Lab.*, **6** (2): 147-168, pls. IX-X.
- 1958. A revision of the genera *Nidalia* and *Bellonella*, with an emendation of nomenclature and taxonomic definitions for the family Nidaliidae (Octocorallia, Alcyonacea). *Bull. Br. Mus. (Nat. Hist.)*, *Zool.*, **5** (5): 103-121.
- 1960. Noteworthy octocorals collected off the southwest coast of Kii Peninsula, middle Japan. Part I, Stolonifera and Alcyonacea. *Publ. Seto Mar. Biol. Lab.*, **8** (1): 1-26, pls. I-II.
- 1961. A revision of the nomenclature of the family Nephtheidae (Octocorallia: Alcyonacea). II. The boreal genera *Gersemia*, *Duva*, *Drifa* and *Pseudodrifa* (n. g.). *Ibid.*, **9** (1): 229-246, pl. XI.
- 1962. Preliminary list of octocorals of Sagami Bay deposited in the Biological Laboratory of the Imperial Household. *Ibid.*, **10** (1): 105-108.
- 1964. Some octocorals from the Antarctic waters off Prince Harald Coast. *JARE Sci. Rep.*, ser. E, no. **23**: 1-14, pl. I.
- (ed.) 1974. Anthozoa. Asahi-Larousse, Shûkan Sekai Dôbutsu Hyakka (Weekly World

- Animal Encyclopedia) (in Japanese), no. 189: 7-27, color pls. 1-20.
- Verrill, A.E. 1864. Revision of the polyps of the eastern coast of the United States. Mem. Boston Soc. Nat. Hist., **1** (1): 1-45, pl. I.
- 1865. Synopsis of the polyps and corals of the North Pacific Exploring Expedition, ...from 1853 to 1856. Collected by Dr. Wm. Stimpson, naturalist to the Expedition. Part II. Alcyonaria. Proc. Essex Inst., **4** (10): 181-196, pls. 5-6.
- 1868-'69. Ditto. Additions and corrections to Alcyonaria. Ibid., **6**: 41-48, pls. I-III (1868), pls. I-II (1869).
- 1869. Critical remarks on the Halcyonoid polyps with descriptions of new species in the Museum of Yale College. No. 4. Amer. Jour. Sci. Arts, ser. 2, **48**: 419-429.
- 1922. The Alcyonaria of the Canadian Arctic Expedition, 1913-1918, with a revision of some other Canadian genera and species. Rep. Canadian Arctic Exped. 1913-18, **8** (G): 1-49, pls. I-XVIII.
- Verseveldt, J. 1964. Notes on Mediterranean *Alcyonium* species (Coelenterata: Octocorallia). Zool. Mededel., **39**: 153-167, pls. XI-XII.
- 1967. The Octocorallia collected by R/V "Vema" in the Atlantic Ocean. Amer. Mus. Novitates, **2282**: 1-17.
- 1971. COctocorallia from North-western Madagascar (Part II). Zool. Verhandl., **117**: 3-73, pls. 1-15.
- 1973. On the validity of *Alcyonium siderium* Verrill (Coelenterata: Octocorallia). Zool. Mededel. **46** (16): 209-216, pls. 1-2.
- 1974a. Alcyonacea (Octocorallia) from the Red Sea, with a discussion of a new *Simularia* from Ceylon. Isreal Jour. Zool., **23**: 1-37, pls. I-X.
- 1974b. Octocorallia from New Caledonia. Zool. Mededel., **48** (12): 95-122, pls. 95-122, pls. 1-5.
- Whitelegge, Th. 1897. The Alcyonaria of Funafuti. Part I. Mem. Aust. Mus., **3**: 211-225, pls. X-XII.
- Wright, E.P. and Studer, Th. 1889. Report on the Alcyonaria collected by H.M.S. 'Challenger' during the years 1873-1876. Rep. Sci. Res. Voyage H.M.S. 'Challenger', Zool., **31** (1). London. lxxvii+314 pp., 49 pls.
- Yamada, M. 1950. Descriptions of two *Alcyonium* from northern Japan. Annot. Zool. Japon., **23** (3): 114-116.

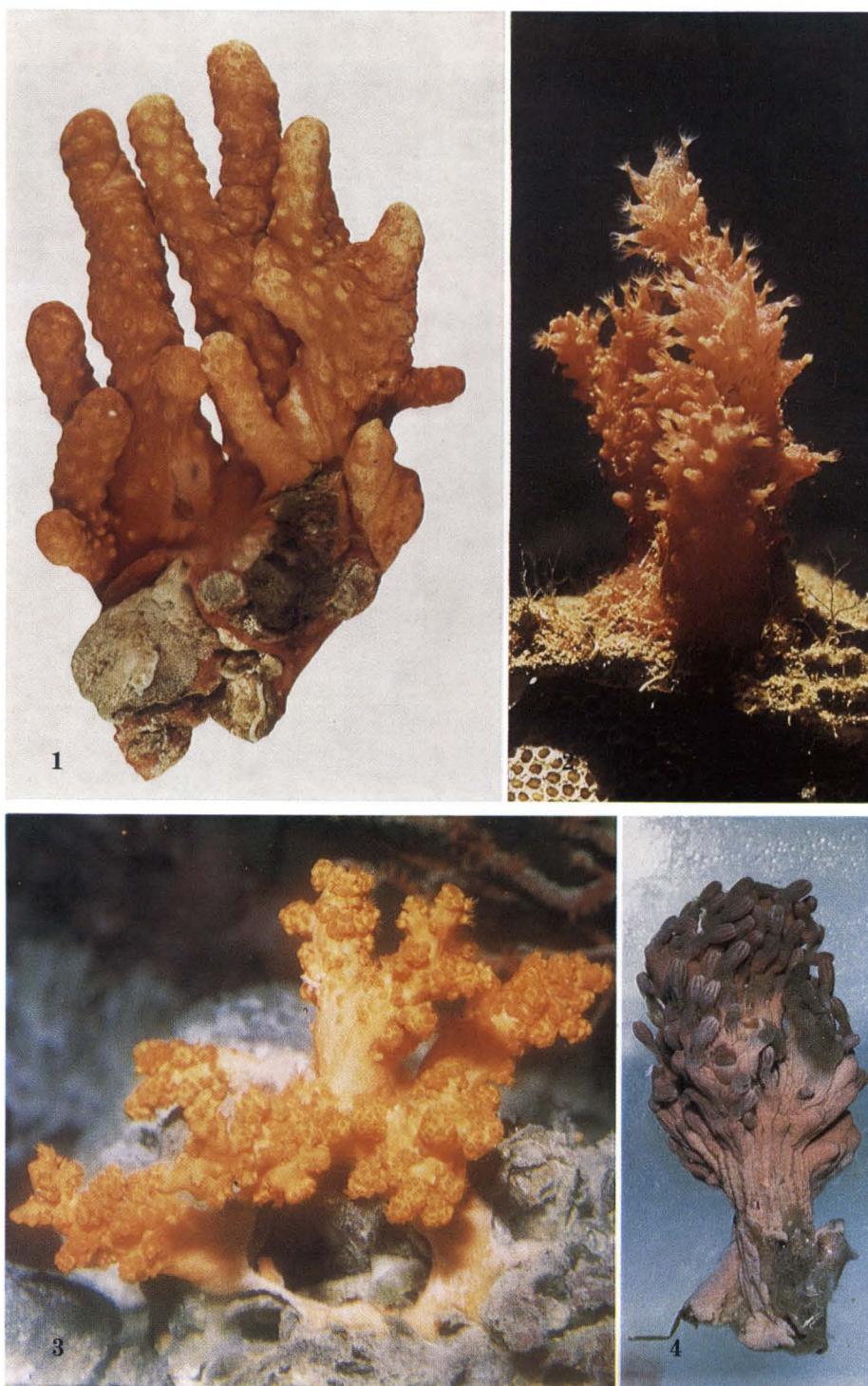
EXPLANATION OF PLATES I-II

PLATE I

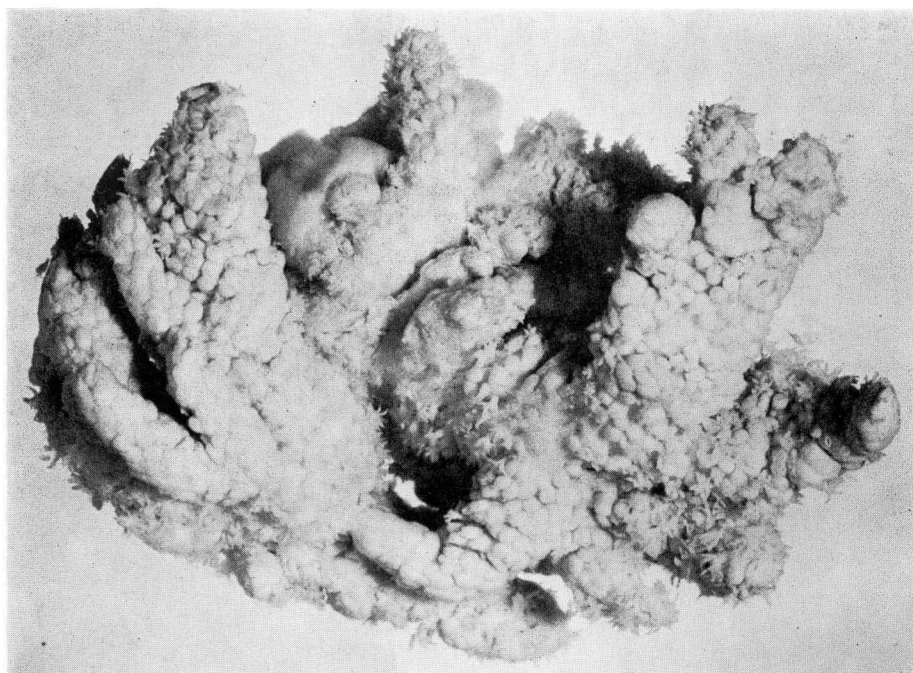
- Fig. 1. *Alcyonium robustum*, sp. nov. Holotype specimen (SMBL-Type No. 249). Photo: Y. Koyama. About natural size.
- Fig. 2. *Alcyonium robustum*, sp. nov. Another living specimen, reared in aquaria, just after collected. Photo: Y. Koyama. About natural size.
- Fig. 3. *Alcyonium gracillimum* Kükenthal. A living specimen reared in aquaria. Photo: E. Harada. About natural size.
- Fig. 4. *Alcyonium* cf. *acaule* Marion. A largest specimen among longtime preserved materials (SMBL-Rare No. 268). Photo: E. Harada. About $\times 1.5$

PLATE II

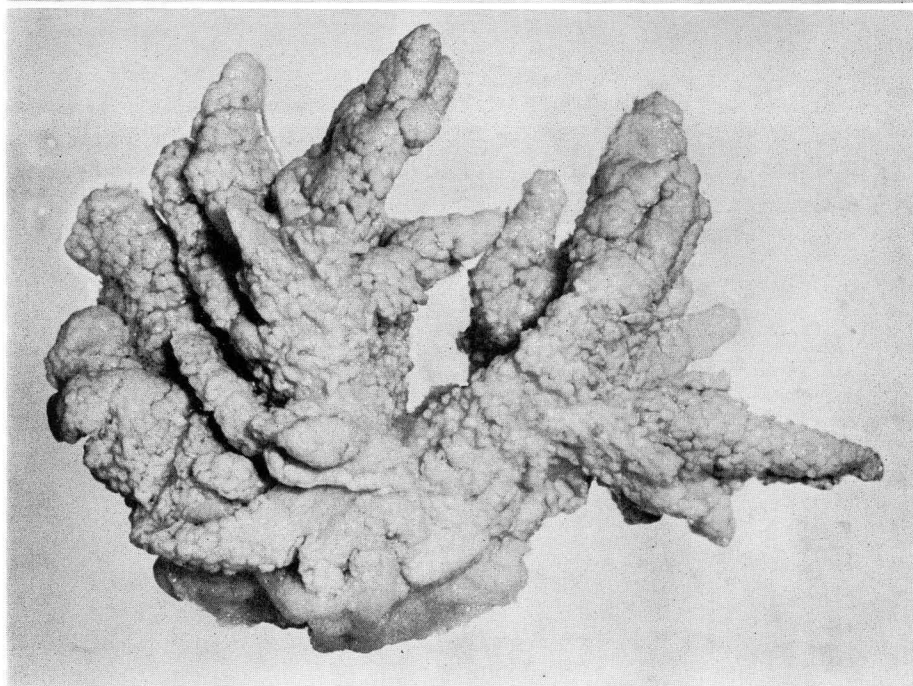
- Fig. 5. *Alcyonium okinawanum*, sp. nov. Holotype specimen (SMBL-Type No. 268), keeping intact, with partly expanded polyps. Photo: E. Harada. About $\times 1.5$
- Fig. 6. *Alcyonium okinawanum*, sp. nov.
The same as Fig. 5, but the lobes are relaxed, as stretching in water. Photo: E. Harada. About $\times 1.5$



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